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Improving Sustainability Concept in Developing Countries

Libyan Electric Network Requirements

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Abstract

Since decades there has been no basic changes in this century for electrical power grid that cannot be fulfilled by the additive technologies of the past one. The emergence of the smart grid new concepts addresses a challenge for the existing electrical networks. The new technologies and infrastructure that enhance efficiency, performance, and reliability of electrical power grid, is the definition of the smart grid. This can be accomplished by new control automation techniques and modern communications infrastructure, that based on having a sensing, metering, monitoring and modern energy management technologies considering the demand optimization, and energy system availability. Libyan Electrical Network as any other electrical system suffering many problems and should be modernized to meet the smart grid requirements or at least to be ready for interfacing with the modernized electrical networks. The main objectives of this paper is to provide a contemporary look at the current state of the Libyan power grid, and to discus as well, the requirements that should be considered for this network to be a smart grid. Also to initiate an open research issues in this field applications for Libyan power grid among the research community, and to start a practical steps for the smart grid Road-Map of Libyan electric system.

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Keywords: SG; ISO; RTO; SCADA.

1. Introduction

Electricity has proven to be the convenient and efficient means of delivering energy. There is no means to store the electric energy without converting it to another form of energy. So the demand for power produced by suppliers must match the power driven by users [generators, and energy storage devices [3].

The utility industries now facing the challenges in the design and operation of the future power grid, where the

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other non-linear loads [5], leads to a modelling shift in the way that power systems are designed and operated. This trend increases the need for smart grid.

Smart grid systems are based on communications between ISO (independent system operators) ,and RTO's (regional transmission organization), and consumers [5], that results in more efficient use of the renewable energy, which leads to better reliable power system and reduction of carbon emission.

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2. Smart Grid Historical View

Smart grid can be considered as a young idea, since it is named in the late 1990's, and practically introduced early 2000's. The first implementation for smart grid was in Italy, that starting in2000's, where about 30 million smart meters were installed across the country [5]. In 2003 United States began setting up its smart grid project in Austin Texas with installing about 300,000 new smart devices, and Boulder city in Colorado State chosen to be the project of smart grid city [6].

After 2003 many countries in Europe and North America take early steps towards implementation of smart grid systems [7]. Some countries like China, India, and Brazil, also prepare the road-map and take some early steps for the smart grid, also Egypt, Thailand, Korea, and Iran start working on the road-map for smart grid systems, and deviated there research force towards smart grid technologies [9].

Now, the number of country's projects for smart grid cities are in progress, but still long way for the smart grid to be the major electrical grid [3].

3. Smart Grid Definition and Applications

Smart grid given many different definitions even though it seems its coming from the same source or idea: Generally, Smart Grid is a type of modern grid that supports all parts of national grid [9]. Smart grid is the next generation of power grid to resolve the problems of the of current power grid systems [1].

Application of smart grid in developed and developing countries, goes through different directions according to their national grid requirements, understanding of smart grid technologies, availability of smart communications means, quality of the their national grid, and scientific and technical force and budgets availability.

According to the definitions of smart grid, which is considered as the tool to increase the power system efficiency with an environmentally friendly way[2], that can be achieved by upgrading the electrical power infrastructure and efficiency of generators, transmission, consumption, and conversion.

Some applications concentrating on the using of the smart devices as the base for smart grid, and others concentrating on the generation and transmission systems upgrading to achieve the highest quality and reliability of power system based on new technology applications of information and communications systems. But the most important part for application of smart grid is the Distribution system or so called Smart Distribution Grid, where the renewable sources taken in consideration for energy integration and consumers attentions.

4. Libyan National Electric Grid and Requirements

Libya is one of the largest countries in North Africa; its area is about 2.0 million square kilometer, with coastline stretched on the southern shore of the Mediterranean Sea for about 2000 km length.

Libyan electric power network systems are linked between the high voltage (220kv and 400kv) networks and low voltage (11kv) networks, through a medium voltage transmission circuits of 30kv,and 66kv. The average demand growth rate over the past three decades was 8% per annum. Accordingly, the generations and network expansions to meet the requirements of this growth have always been the consequent result. The cables and overhead lines for power transmission are about 22,258 km long, and the number of 30kv network installed substation is 355, and 175 substations for 66kv network besides the low voltage substations and transformers. The peak load is about 6000 MVA [10]. Libyan power grid is one of the best grids among North African countries, it’s always updated and renewed until

year 2010 before Libyan wars, that helps the power grid to stand the damages occurs due these wars.

Fig. 1. shows the divisions of geographical regions of Libyan area.

The four main circuits (East, West, South, and South east) are connected and controlled by a central dispatch and each circuit has its own control unit, and all circuits are connected and controlled with a good SCADA system that gives the ability for the grid to be automatically controlled.

The requirements for the Libyan power grid to be a smart grid is mainly matter of decisions that should be taken by authority and budget availability, but the technical steps can be summarized as follows: Renewing the power grid components considering a replaning project by installing a smart devices throughout the network

Build and / or upgrade the SCADA system as well as the communication system to be up to dated.

Heavy training (inside and abroad) to the technical staff of the GECOL (general electrical company of Libya) in the field of controlling, using , maintaining , and operating the new smart devices ,and SCADA system software's.

Build a special supervisory staff for preparing the information for the decision makers.

Supporting widespread use of distribution energy resources by upgrading the infrastructure of the grid to be flexible for use of distribution energy resources such as fuel cells, micro turbines, and renewable generations at homes, offices, and factories.

5. Smart grid Road-Map considerations for Libyan Electric Network

As an origin vision, to start thinking about implementing Smart Grid (SG) in Libya; there should be a steps to follow after performing the community of SG or at least a Group called SG group. This group as a leader group that should start the Road Map for Libyan SG ,and perform the plate form which will describe the SG landscape, it's drivers, and technologies, also the values of international and local collaboration in technology innovations and search for solutions.

Libyan electric power network needs a proper monitoring and improvement that requires a prepared plane for energy integration, renewable energy penetration, investment, and public awareness for a smart grid. Libyan researches (academia, and private) and the authorities of the electric energy In Libya should starting building a plans for solution architecture of energy in Libya, that leads to form the construction and infrastructure of future grid in Libya. Also there is a need to a deployed technology road-map approach to identify the research and developments needed to support the smart grid in Libya.

The following research articles can be considering for Libyan power grid:

- Suggestion on how to construct the Libyan power smart grid considering the local one as a base.
- The required developments in Libyan power generation, transmission, distribution systems infrastructure to meet the requirements for smart grid considering the renewable energy penetration.
- Identifying the fields of lacking technologies for smart grid implementation such as: energy technology, operational technology, communication technology, information technology, and consumer technology, and, putting

such fields in a priority manner.

Also an Investment Evaluation System should be developed based on a Unified Information Platform for integration of information and data that helps for future smart grid in Libya. As any developing country, an overall plan can be suggested for Libyan power smart grid that can be summarized in the following figure.

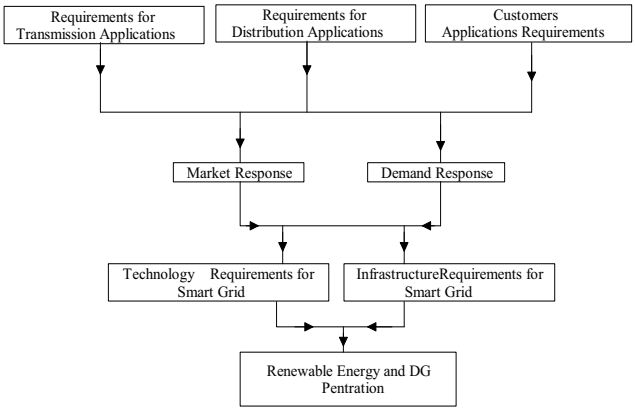

Fig. 2. Road-Map General Approach For Libyan Smart Grid.

6. Conclusions and Recommendations

This study results the following

6.1 Conclusion

Libya as a developing country still not starting yet the construction of electric Smart Grid, even though, it's basic electric grid is one of the best grids among Northern African's countries.

There is some starting research for smart grid in the Academic and Universities level and Libyan Electric Company GECOL. A group of research for SG is started in EE department of Libyan Academy in connection with GECOL.

In this paper a Road-map for Libyan electric smart grid is the first time developed that will be the base idea for the authorities and researchers to start with. The research should focus on array of issues and challenges, that include the convergence and integrations of enhancing power system ,and power electronics with information and communications technologies ICT. Also the relationships between SG and renewable energy resources, services for consumers, new business models for utilities, and SG projects.

6.2 Recommendations

The research should be directed to the following issues:

1- GECOL should starting upgrading the grid equipment and install new smart devices in all grid sections oh generation, transmission, distribution, and customers.

2- Starting survey studies about customers needs choices, partnerships in energy generations and exchanges.

3- Encouraging the stockholders to build new projects in renewable energy fields, especially in the photovoltaic and wind energy due the high availability in Libya.

4- Concentrating on having the new storage systems of electrical energy and isolating art grids since Libyan population concentrated in a semi-desert areas out of the main cities.

5- Authorities should push more and more for research in the SG area and provide more grant supports to research Academic and universities.

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